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# Multilateral Approaches to Market Access Negotiations in Agriculture: Processed food trade and developing countries

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## Abstract

*Exports of processed foods from developing countries have expanded rapidly in recent times, contributing to those countries' development. Recent research showed that the developing country exporter's 'openness' and agric resource endowment offer significant explanations of this export growth. But what if 'openness' is enhanced? What if processed and other food trade barriers are lowered? What if trade in manufactured goods is further liberalised? Would developing countries continue expanding processed food exports, or would resources be drawn into textiles and manufacturing? This paper discusses some approaches to multilateral negotiation of improved market access, and then applies one such approach in an attempt to shed light on the above questions.*

## Introduction

Fuelled by rapid income growth and urbanisation, lifestyle changes and improved marketing infrastructures, food consumption patterns in many developing countries are exhibiting the substitution of high-value processed foods for traditional foods. Associated with this phenomenon is a major change in the composition of international trade in food and agricultural goods. Processed food's[1] share of total global agricultural trade increased from 40% to 50% over the 1965-1985 period, but increased more rapidly to over 60% by 1995. Developing country exporters are cashing in on this accelerating growth, and over the past decade the growth of their processed food exports has exceeded that from the developed regions. By 1995 the total value of global processed food exports was 2.5 times as high as that in 1985, but for unprocessed agricultural commodities the increase over this period was only 1.5 times (Figure 1).

The Uruguay Round Agreement on Agriculture (URAA) put in place a set of rules that significantly improve the conditions for market access for agricultural goods. Bound tariffs have almost entirely replaced non-tariff measures, and exporters now have a much clearer view of the conditions for entry into markets. Most commentators agree, however, that the Agreement did little to liberalise trade in agricultural products and actual improvements in market access were modest (IATRC 1994; Josling 1998). The process of 'tariffication' produced a number of tariffs so high that it is difficult to see any profitable trade opportunities developing in such markets. The same can be said for the out-of-quota tariffs in many of the tariff rate quotas that cover processed foods as well as raw commodities. Thus there is much unfinished business to be addressed in a new round of multilateral talks on agriculture.

Generally, the URAA did not reduce tariffs more for processed products than for basic agricultural products and the reductions are less in many cases (OECD 1997). For the OECD countries where tariffication was applied to processed products, the high base tariffs set for some basic commodities carry through to the processed products that use them as inputs, and in some cases additional protection is also included. While tariff escalation was reduced in some instances it still persists in a number of cases, especially for coffee, cocoa, oilseeds, vegetables and fruits.

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[1] Meats, vegetable oils and fats, dairy products, processed rice, sugar, beverages and tobacco products and 'other processed foods', as defined in the GTAP Version 4 database.

An earlier study of the authors (Josling and Rae 1999) examined a number of modalities for reducing the levels of agricultural tariffs, and found that in some cases the reductions in processed food tariffs contributed a large proportion of the developing countries' welfare gains. This, coupled with the knowledge that growth in processed food exports was especially rapid in the case of developing countries, encouraged us to examine the issue more deeply. Further, it has been shown that 'openness' is an important factor in explaining the growth in processed food exports from developing countries (Athukorala and Sen 1998) which raises the question of how increases in openness, as might be negotiated in a future round of trade negotiations, might impact on the processed food sectors of developing regions.

The paper next reviews some trends in processed food trade, with a focus on developing countries and factors associated with processed food export growth from such regions are discussed. Several issues in market access for agriculture and processed foods are discussed next, followed by discussion of tariff escalation and effective rates of protection of processed food sectors. The GTAP applied general equilibrium model is then used to conduct two liberalisation experiments to illustrate the impact of possible trade reforms on international trade in processed foods.

**Processed Food Exports and Developing Countries**

Between 1975 and 1985 the value of global processed food trade increased by 5% per year, but grew at almost double that rate from 1985 to 1995 (Table 1). While the growth in processed food exports during the former decade was fuelled mainly by exports from developed countries, processed food exports from developing countries played a more important role over the latter decade. In 1985 processed foods accounted for 55% of the total agricultural exports of developed countries, but only 40% of those of developing countries. Ten years later processed food's contribution had grown to almost 56% of the developing world's agricultural exports, and 66% of those of developed countries.

Annual growth in global exports for many of the process foods listed in Table 1 exceeded 9% during 1985-95, while exports of vegetable oils and fats, and processed rice grew at a slower rate. Growth rates for all commodities over the previous decade were slower, with the exception of vegetable oils and fats. Global sugar exports actually declined 9% per year from 1975 to 1985. Similar patterns are to be seen in the export growth data for the developed countries. The situation is somewhat different for the developing regions, however. Fastest export growth rates (almost 20% per year) over 1985-95 are found for dairy products (but from a very small base) and beverages and tobacco. Developing countries' rice exports grew by 10% per year over 1985-95, but by under 2% annually over the earlier decade. Sugar exports from developing regions also picked up over the 1985-95 decade after falling by 11% per year during 1975-85.

The 'other processed foods' aggregate had by far the largest share of total processed food exports of both developed and developing regions in 1995 (Table 2). This aggregate comprises processed fish, fruit and vegetable products, grain mill products (except rice), bakery products, cocoa, chocolate and confectionery, processed animal feeds and other processed foods not elsewhere specified. Given this large number of items, it is perhaps not surprising that together they comprised nearly 40% of developed countries processed food exports in 1995, and over one-half of those from developing countries. The more disaggregated data examined by Athukorala and Sen (1998) suggests that very rapid growth in processed fish exports from developing countries could have been a major factor in the recent dominance of the 'other processed foods' group in their total processed food exports.

Because of the importance of this group of processed foods in total processed food exports from developing countries, it will be a focus of this paper.

One-half of the value of global processed food trade takes place between developed countries (Table 3). The value of such exports from developed to developing countries is almost the same as the flow in the opposite direction. Processed food trade between the developing countries themselves has been increasing however – this made up 11% of global trade in 1985 but had risen to over 14% in 1995. This is perhaps not surprising given the increasing growth of processed food exports from developing countries, and the rapid demand increases that are occurring in many of those countries. In monetary terms, processed food trade between developed countries increased from US$59 billion in 1985 to US$149 billion in 1995, or an increase of 150%. Such trade between the developing countries increased over the same time period from US$13 billion to US$41 billion, or by 205%.

Often, manufacturing expansion is believed to contribute to superior growth performance in developing countries than strategies that emphasise agricultural development. Athukorala and Sen (1998) challenge this view, and suggest that the labour-intensity of much food processing implies the expansion of this sector could have a strong positive effect on employment generation in the typical labour-surplus developing country. Further, other supposed benefits of manufacturing expansion such as knowledge and technology spillovers may be just as important in food processing activities. Where food processing relies more heavily on domestically-sourced imports than does manufacturing, then expansion of the processed food sector may also produce greater 'spread' effects, through input linkages, on the domestic economy. Athukorala and Sen then proceed to test the hypothesis that inter-country differences in processed food export growth rates are influenced more by the trade policy regime than by resource endowments. Their econometric results are shown to support this position for their sample of 36 developing economies. The authors conclude that while resource availability is fundamental, export success with processed foods depends crucially on the nature of domestic trade policy.

**Issues in Market Access for Agriculture**

The aspect of domestic trade policy which is particularly important for the processed food sector is that which governs the conditions of trade for primary products, generally of agricultural origin. Thus market access for agricultural goods is a key determinant of the development of processing activity. Agricultural markets have traditionally been ruled by a different set of regulations, institutions and political considerations than have those in manufactured goods. The process of making these two systems converge has proved difficult, but the Uruguay Round made a start in that direction. The task for the next agricultural round, which was launched in March 2000, is to continue this process. How successful these negotiations will be is a question of considerable interest to the processed food sector.

Two objectives have been discussed for the market access negotiations that would move agricultural markets in line with those for other products. These are (i) a substantial reduction in the average level of tariffs for agricultural goods, (ii) the reduction in the dispersion of tariff rates among agricultural products. These objectives are discussed briefly below.

*Reduction in the average level of agricultural tariffs*

The level of agricultural tariffs is several times that of manufactured goods. This constitutes a major distortion in world trade, to the detriment of most countries. One major objective of the next round will therefore be to reduce the level of protection for agricultural goods to be much

closer to that of industrial products. It is hardly likely that the gap can be closed in the next round. However the talks will have failed if there is not a significant reduction in the level of agricultural tariffs and hence in the disparity between market access in agricultural and industrial goods. Bold initiatives are probably better than modest proposals, though they have to have some underlying rationale to be credible.

Several ways could be suggested for achieving the objective of reducing average tariffs in the new Round. One could, for instance, use the same base that was established in the Uruguay Round for the next set of tariff cuts (Tangermann, 1997), and even use the same depth of tariff cut. It would be relatively simple to specify the objective: one would merely be replicating the UR tariff cuts over a similar time period. The advantage of this approach is that it emphasizes the continuity of the process. Countries against the idea would in effect be arguing to slow down the pace of liberalization. In addition, the effect on trade would actually accelerate somewhat over time: the percentage cuts would not be diluted by the reduction of the base. The use of the same base simplifies negotiations, as a reopening of the issue of the base would itself cause controversy. But perhaps the strongest reason for supporting such an approach is that it simplifies and clarifies the question of "credit" for unilateral moves taken during negotiations. Countries would no longer need to delay unilateral reductions in border protection for fear of "paying twice": the unilateral policy change would count towards the reduction as it will have occurred after the base period.

There are drawbacks to such a simple approach. One is the impact that it would have on developing country participation in the trade system. Developing countries may argue that they should again be subject to smaller cuts over a longer period: they would certainly raise problems if it were suggested that they "catch up" with the industrial countries. But if one continued with the reduced cuts and longer time horizon for developing countries, by the end of the "second" transition period many countries will be way behind with tariff cuts. This risks splitting the market into a "liberal" and an "illiberal" group of countries. Developing countries may risk being left out of expanding trade opportunities as a result of their higher levels of protection.

At the other extreme from a simple continuation of the UR tariff cuts is a reversion to a time-honored way of negotiating tariff reductions known as "request and offer". This technique relies on countries making requests to others, particularly on commodities of which they are the principle suppliers, and in turn offering to make cuts in their tariffs. Once agreed, the tariff cut offers are then "multilateralized" to other WTO members. It is common for such request and offer negotiations to be constrained by some overall target reduction, but the result is bound to be more eclectic.

The technique has severe drawbacks from the point of trade liberalization, though its attraction to domestic interests is clear. First, the tariff cuts on offer are likely to be heavily limited by political constraints. It is unlikely that countries will expose their most sensitive sectors willingly unless they are sure of getting significant "gains" from others. As a result it is unlikely that request-and-offer negotiations will reduce tariff disparity. Secondly, the developing countries have so far not been major players in request-and-offer talks. They have had relatively little to give, and not sought much in return. A request and offer negotiation could well turn into a US-EU-Japan trilateral bargain, with little of interest to developing countries on the table. Some tighter framework for market access negotiations is needed, even if certain aspects of the talks do in the event make use of a modified request and offer procedure.

As an alternative to a further round of differentiated tariff reductions based on average cuts, or to a request-and-offer approach, countries could agree on a rule of "no exceptions" to the agreed cut. This then becomes an "across-the-board" tariff reduction.[2] One could perhaps aim at a 50 per cent cut in all tariffs over a seven-year period. This would have the advantage of simplicity and transparency. It could be combined with the device of using the same base period, or it could apply to the bound tariffs as of an agreed date, say the year 2000. In the past, such across the board cuts have often been riddled with exceptions. This would need to be kept under control.

An across the board cut would, however, still leave some tariffs at a very high level. Just as problematic, it would give the "reluctant" liberalizers the central role in the negotiations. A coalition of countries who have domestic reasons not to liberalize would strongly object to any bold cut in tariffs, and one could end up with a relatively small cut at the end of the negotiations. The technique of across the board cuts would be considerably enhanced if it could be coordinated with cuts in non-agricultural tariffs. If it was proposed that all tariffs, agricultural and non-agricultural, were to be cut by (say) 50 percent then it is possible that a deal could be struck. In fact this outcome would be facilitated by subsuming agricultural tariff cuts entirely in a general agreement on a particular an overall reduction.

*Reduce tariff peaks*

Besides the generally high level of tariffs in agriculture, the variability of those tariff levels is striking. This has arisen for at least three inter-related reasons. First, the politics of agricultural protection has led to strong pressures for trade barriers against imports which compete with staple or basic commodities (such as rice, wheat, sugar and dairy goods) but often allows more liberal access for products which are seen as less essential in food supplies (for example fruits and vegetables) or are required for feed or food processing (in particular animal feed and oilseeds).[3] Secondly, the method of supporting the basic industries has in the past reflected this political imbalance, with government controls (state trading or non-tariff barriers) dominating the sensitive markets while other products were protected by tariffs. The act of tariffication has finally revealed the height of such protection and has directly led to the problem of tariff peaks. A third influence has been the method of negotiating trade barrier reductions over the years, which allowed certain sectors to escape disciplines. Commodity subcommittees within the agricultural negotiations in many of the Rounds had the effect of diverting attention away from the need for a balanced approach (Josling, Tangermann and Warley, 1996). Request-and-offer techniques reinforced this tendency to focus on a few sectors. Even when the Uruguay Round Agreement mandated average cuts in agricultural tariffs of 36 percent, countries were given some flexibility as a result of the minimum required cut of 15 percent on each tariff line.

Tariff peaks pose a problem for the agricultural trade system for two reasons. The most important is that the economic cost of a tariff is roughly proportional to the square of the height of the tariff. Cutting high tariffs is the surest way to get gains from trade. Secondly, the high tariffs can generate significant profits for import competing industries and encourage rent-seeking behavior. In one respect, cutting tariff peaks can also be easier than reducing

[2] This was the choice made in the Kennedy Round for industrial goods after the previous rounds, based largely on request-and-offer, had not produced the required liberalization (Josling, Tangermann and Warley, 1996).

[3] Countries with limited land resources relative to population have sometimes had relatively liberal policies even on staples. But many countries with climatic or other disadvantages to farming have tried to compensate with high levels of protection.

tariffs across the board. It may be easier for countries to "sell" the water in their current schedules, in effect making cuts in prohibitive tariffs.

As a direct way of reducing tariff dispersion, agricultural tariffs could be reduced on a formula basis, with higher tariffs being reduced at a greater rate. The 'Swiss Formula' that was used for tariff reductions in industrial goods in the Tokyo Round might seem to be an appropriate technique to use.[4] This would certainly be a faster way to get liberalization than the across-the-board cuts. Much of the 'water' would be squeezed out of the high tariffs (and the element of 'dirty tariffication' removed) by such an approach.[5] The main advantage of using a formula approach is that it would reduce the dispersion of tariff levels among products. The process of tariff reduction in the Uruguay Round may indeed have increased the variance of tariff levels.[6] But formula reductions appear to put more burden on those countries with dispersed tariff rates, and they might be expected to argue for more uniform cuts. Moreover, the Swiss formula appears to be more naturally suited to a set of tariffs in the range 5-25 percent. With the coefficient used in the Tokyo Round, this would drive all the higher tariffs down to below 15 percent, while having little impact on the lower tariffs. If one starts with mega-tariffs of up to 300 percent, the effect is too draconian: they too would come down under the formula to about 15 percent. It is hardly likely that countries that swapped quantitative control over imports for mega-tariffs in the Uruguay Round will suddenly reduce them to such a modest level. The Swiss formula can however be rehabilitated for the mega-tariffs by using a much higher coefficient, in a way that will be illustrated below.

A second approach to reducing the dispersion in tariffs is to put an upper limit on all tariffs on agricultural goods. If it were to be agreed that no agricultural tariff could remain above, say, 100 percent after a transition period, then all the mega-tariffs would be capped. However, this is clearly not a constructive way to address the issue of market access over all commodities. It would imply no reductions in tariffs for those commodities with significant protection that happened to be under 100 percent. It could be a reasonable approach to the issue of water in the tariff: one would assume that the very high tariffs have the most water. The concept of tariff ceilings could therefore be usefully employed along with other techniques. For instance, a combination of an across-the-board cut by 36 percent and a tariff ceiling of 100 percent could prove palatable for importers as well as attractive to exporters.

A third way of reducing tariff dispersion, and of increasing market access in general, is to continue the process of expanding minimum access as a proportion of consumption. The mega-tariffs are commonly associated with the process of tariffication of non-tariff barriers. The low tariff that operates within the quota may give a useful lever for market access. An increase in TRQs, say, of one per cent of the level of domestic consumption in each year over a five-year period would undoubtedly remove much of the restrictive effect of the quotas. In most markets the quotas would become non-binding before the five-year period was over. In

[4] The basic "Swiss" formula can be written as $T(1)= a*T(0)/(a+T(0))$, where $T(0)$ is the existing tariff and $T(1)$ is the new tariff. A value of $a=16$ was used in the Tokyo Round (Laird and Yeats 1987).

[5] The 'water' in a tariff is the unused protection when no imports can sell at the tariff inclusive price. The 'dirty' element in the agricultural tariffs refers to the use of price gaps between domestic and world markets that overstated the existing protection at the time of tariffication, leading to larger than necessary tariffs. Tariff bindings were also often set well above the actual tariff in operation, giving an element of discretion to governments. Thus a reduction in the high rates of tariff removes the water, cleans up the tariff and removes the discretionary element of ceiling bindings.

[6] This was the case, for example, in the EU, Japan and the USA. See Tangermann (1995).

effect, tariffication would have taken place at the level of the reduced tariff applicable to the TRQ.[7]

The main overt political objection to this could be that the "within quota" tariffs were generally left to the discretion of the importing country to fix at levels that they judged would attract the guaranteed access quantity. The tariff levels were never meant to protect the domestic producers. Indeed it would have made sense for all within-quota imports to be duty-free. This implies that some form of re-negotiation might have to take place on the level of these tariffs. This of course also offers a possibility to set such tariffs for within-quota trade at a reasonable level in relation to other goods. All "within quota" tariffs could be bound at (say) 20 percent, and not reduced until they became the operative tariff for the bulk of agricultural trade.

There is however a less apparent reason for thinking that expanding the TRQs could be politically difficult. If goods enter beyond the TRQ then the quota quantity itself will be sold at a price governed by the above quota imports. In effect the difference between the within and the above quota tariff will represent the quota rent, distributed between importing and exporting agents depending on the method of allocation and the market structure. If those who gain the rent are also influential in the setting of the agenda for the negotiations then the enthusiasm for expanding TRQs will be moderated.

*An integrated approach*

The methods of market access discussed above each have some merit but might not be adequate in themselves. This suggests that one could try a "cocktail" of the various modalities. One such mix is suggested here, but others are of course possible. Imagine agricultural tariffs divided into several categories. Low tariffs, say those less than five percent, could be reduced to zero, as neither the level of protection nor the revenue collected are likely to be significant. Such nuisance tariffs could be removed with advantage, in agriculture as well as in other areas. Moderate tariffs, of 5-40 percent, could be reduced by a further 36 percent cut, as in the Uruguay Round. The tariffs above 40 percent are probably too high to yield to the same techniques as industrial tariffs: a combination of tariff cuts and TRQ increases may be needed. Thus for tariffs of between 40 and 100 percent, the 36 percent cut would be augmented by an expansion of TRQs. For the tariffs above 100 percent, some variant of the Swiss formula may be needed. And for those tariffs that are above 300 percent it may make more sense to conduct particular "request and offer" negotiations with principle (potential) suppliers. A variant of this cocktail approach, without the quantitative changes is explored empirically below.

**Data and Regional/Commodity Aggregations**

The version 4 GTAP database, which is benchmarked to 1995, was aggregated up to the level of 15 regions (Appendix Table 1) and 20 commodities. Several tariffs were modified prior to any simulations being undertaken.[8] These included tariffs in Korea (wheat, dairy, cattle, meats and rice), the EU (sugar, dairy and meats), South Asia (wheat), China (sugar cane and beet, meats and sugar) and ASEAN (grains, sugar cane and beet, meats, dairy, rice and sugar).

[7] It would also be possible to devise a way to give countries the option of TRQ increases or tariff decreases, as both lead to the same desirable end. This is further explored below.

[8] These additional tariff data had been prepared by Dr David Vanzetti of the Australian Bureau of Agricultural and Resource Economics.

Josling and Rae (1999) showed that, under some approaches to tariff reforms, around one-half of the total welfare gain of developing regions was attributable to the cuts in tariffs on processed rice, vegetable oils and fats, beverages and tobacco and 'other processed foods' products. However that study aggregated all these commodities into a single processed foods sector, so the contributions of tariff cuts to these individual processed foods was not obtained. Therefore in the current study we model each of these commodities as separate sectors. Thus seven of the 20 commodities are processed foods, and were chosen to represent our interests in the impacts of trade liberalisation on those sectors. These are meats (ruminants and non-ruminants), vegetable oils and fats, dairy products, processed rice, sugar, beverages and tobacco products, and 'other processed foods'. As noted earlier, the latter product group has the largest share of processed foods exports for both developed and developing region aggregates in the 1995 database, and for that reason will be the major focus of our attention. As indicated earlier, it comprises processed fish, fruit and vegetable products, grain mill products (except rice), bakery products, cocoa, chocolate and confectionery, processed animal feeds and other processed foods not elsewhere specified. All remaining production sectors are aggregated into other natural resource based commodities, textiles and clothing, manufactures, and services.

**Tariff Escalation and Effective Rates of Protection of Processed Food**

The level and dispersion of tariffs on the raw material are not the only concern of processed food manufacturers. The relationship between the protection of the input items and that of the output is important. "Effective protection" is the concept used to describe the benefit of low input tariffs combined with high output tariffs for the food processor. The effective protection compares the value added (output value less the cost of purchased inputs) at protected and unprotected price levels. High effective protection (high protection of value added) in an importing country will discourage the spread of processing to the exporter.

Many developing countries still derive a large percentage of their export earnings from the sale of agricultural raw materials. These raw materials often enter the developed markets with low or zero tariffs, either under a preferential system or as a reflection of the desire not to burden the processing sector. But it has long been recognized that this can have a negative impact on development in those countries supplying the raw materials. An escalation of tariff levels from low tariffs on raw materials to higher tariffs on processed goods results in high levels of effective protection of the processing activity. This can inhibit the growth of the processing activity in the developing country.

The high levels of tariffs on temperate zone farm products, in particular the basic commodities which once formed the backbone of the agricultural sector in industrial countries, is in sharp contrast to the low protection on imports of tropical products and raw materials. This will sometimes result in low or even negative protection of the processing activities. In other cases the processed product is protected by tariffs which themselves incorporate the duties paid on the raw materials. For this reason, care should be taken to avoid maintaining those processed tariffs whilst reducing the tariffs on the raw material.[9] It is unlikely that the tariffs on temperate zone commodities will come down fast enough to cause

[9] An example of this phenomenon is the setting of tariffs for pigmeat in the EU. The MacSharry reforms lowered grain prices by 30 percent. This should have lowered pigmeat tariffs. But the formula used for calculating the tariff for pigmeat did not reflect the drop in grain prices, and thus left that activity with a higher level of protection as a result of tariffication.

a widespread problem of high protection to the processing sector: the tariffs on many processed goods are lower than on the raw materials.[10]

An examination of the evidence of protection on raw materials and processed goods illustrates this situation. Table 4 shows the level of effective protection for the 'other processed foods' sector (i.e. protection of value added in sectors other than meats, dairy, vegetable oils, rice and sugar) for 14 countries and regions (and a "rest of world" category) as calculated from the GTAP database. Effective protection was positive for all regions/countries except Japan, Korea and the EU (and the rest-of-world aggregate). For the latter regions, this reflects high levels of protection on inputs which hamper the development of food processing industries.

The significance of this can be seen by comparing the effective protection with the nominal protection (i.e. the protection on the output goods). Moderate to high positive protection of the processed product is noticeable in South Asia, as well as in Korea and the ASEAN countries, China the FSU and North Africa. In South Asia this is partially offset by protection on the input items. In ASEAN and Central-South America as well as in the FSU and North Africa, input protection is lower, giving a positive incentive to processing activities. Low levels of output protection for processed foods are apparent in the US, Canada, Australia and New Zealand. But in these cases protection of value added in processing is positive though modest, indicating that high input prices do not imply a net tax on processing activities.

The implicit tax on processing which arises from the higher tax on inputs can be further broken down into that which comes from agricultural inputs and that which is due to manufactured inputs. The last two columns of Table 4 attempt this disaggregation. The highest implicit taxes on agricultural inputs occur in Korea, Japan and South Asia (and the rest-of-world aggregate).[11] Manufactured inputs implicit taxes are above 10 percent only in the case of South Asia. In all cases except Australia, the implicit tax from agricultural inputs exceeds that from manufactured inputs.

These results give an indication of what effects on this 'other processed food' sector might come from further liberalization of market access in agriculture and in manufactured markets. Agricultural input costs could be reduced considerably in Korea, Japan and South Asia to the advantage of the food processing industry. In the case of Japan and Korea the effect might be enough to remove the negative effective protection. The processing sector in these countries might be expected to expand and possibly secure some export markets. Reduction in nominal protection of the processed goods would lower this incentive to expand. Other countries have less to offer their processing sector in the way of relief from high agricultural input prices. In Central and South America, the FSU and North Africa the effective rate of protection could increase with liberalization of agricultural trade.

Distortions in economic incentives occur when protection levels, both among products and between stages of production diverge. Such divergence is apparent at present, and could increase or decrease depending on the way in which market access is improved. If trade policy changes reduce this dispersion there is a presumption of increased efficiency in the

[10] This phenomenon of negative effective protection for food processing is one reason to expect pressure from the processing industry to lower tariffs on agricultural goods (Josling, 1999).

[11] In this case Europe has a relatively low implicit tax from agricultural inputs, but for this category of 'other processed foods' the highly-protected meat, dairy and sugar based products comprise less than 10% of the processing sector's total cost. Even this small tax is enough to drive the effective protection negative.

allocation of resources. The empirical estimates that are presented below attempt to put some quantitative meat on the bones of this proposition.

**Simulation Methodology and Experiments**

For the estimation of the benefits of certain types of market access modalities, the GTAP applied general equilibrium model was used (Hertel 1997). This is a multi-region model built on a complete set of economic accounts and detailed inter-industry linkages for each of the economies represented. The GTAP production system distinguishes sectors by their intensities in five primary production factors: land (agricultural sectors only), natural resources (extractive sectors only), capital, and skilled and unskilled labour. In trade, products are differentiated by country of origin, allowing bilateral trade to be modeled, and bilateral international transport margins are incorporated and supplied by a global transport sector. The model is solved using GEMPACK (Harrison and Pearson 1996).

Josling and Rae (1999) explored three approaches to agricultural tariff reduction:
( i) All tariffs were reduced by 36%.
(ii) Tariff reductions were computed using the Swiss formula. The effect of using this approach was to reduce higher tariffs proportionately more than lower rates, thus reducing the variability amongst tariffs. It would also tend to reduce tariff escalation (or de-escalation) within processed food production systems. We set a=150 in this formula (see footnote 4), which implies that tariffs below 85% will be reduced by less than 36%.
(iii) A 'cocktail' approach that combined the above tariff reductions as follows:
tariffs less than or equal to 10% were eliminated;
tariffs between 10% and 85% were reduced by 36%; and
tariffs greater than 85% were reduced by the Swiss formula (a=150).
Thus the Swiss formula was used to cut the highest tariffs, but lower tariffs (those between 10% and 85%) were cut by 36% rather than the lower amounts that would apply through use of the Swiss formula. The lowest tariffs (those less than 10%) were assumed to be completely liberalized.

The experiments simulated by Josling and Rae (1999) demonstrated that the global welfare gain was greatest for the 'cocktail' approach to agricultural tariff reductions. Further, of the three formulas the 'cocktail' approach gave the greatest welfare gains for the majority of developing regions in that application. For these reasons, we shall focus on the 'cocktail' formula here[12], and apply it to all agricultural and food tariffs[13] in experiment 1.

Josling and Rae (1999) also showed that changes in the output of manufacturing (and service) sectors had a substantial impact on the realised welfare changes from agricultural tariff reforms in several regions. That study did not examine the reform of manufacturing tariffs, so a second experiment in the current study will apply the 'cocktail' formula to the reduction of manufacturing sector tariffs also. This could be of particular interest in a study of tariff reform and processed foods, since manufactured products are important inputs to processed foods production. Changes in manufacturing protection could have substantial impacts on value-added in processed foods production and hence its effective rate of protection.

[12] The above three experiments were repeated with the current data and aggregation, and confirmed that the 'cocktail' formula did result in the greatest increase in global welfare. Further, the developing regions as a group obtained by far the greatest welfare gain from that approach to tariff reductions.

[13] The GTAP database includes instances of negative tariffs (market prices less than border prices). In our simulations, these negative tariffs were not adjusted. Further, the version 4 GTAP database applied observed domestic/world price gaps at the commodity level on both the import and export sides. Thus in the simulations where tariffs are reduced, an equivalent reduction is also made to export subsidies.

**Results**

*Experiment 1: Reduction of agricultural tariffs*

Impacts on the effective rate of protection of 'other processed foods'

An across-the-board reduction in agricultural tariffs could either increase or decrease effective rates of protection. For example, the impact of a fixed percentage tariff reduction will depend upon whether the processed food output, or the intermediate inputs, carried the largest tariffs. Differential tariff cuts, such as those achieved using a Swiss formula, will also have uncertain impacts on the ERPs as the tariff cuts applied to processed food outputs and inputs could differ, depending on the sizes of those tariffs.

Table 5 compares the ERPs of 'other processed foods' production following the reduction of agricultural tariffs[14] with base values. For Japan, Korea and the ROW (which includes the EFTA countries), the base ERP was negative and the tariff cuts have reduced this taxation of processed food production. For most developing regions apart from Korea, the positive base ERPs are reduced under the agricultural tariff cuts, and the new ERP for South Asia is close to zero.

What changes in processed food outputs, exports and trade balances might have accompanied the above changes in effective protection? It is not possible to reach conclusions based on changes in protection alone, since the tariff cuts affect protection of all sectors in a general equilibrium world. Such changes are explored in following sections.

Impacts on processed foods outputs and trade

Of all regions (excluding ROW), the expansion of 'other processed foods' output as a result of tariff cuts was greatest in Korea (Table 6). While the 'cocktail' formula reduced Korea's NRP in this sector from 16.9% to 9.4%, the reduction in the implicit tax on agricultural inputs to the processed food sector declined much more, from a base value of 62% down to 32% (Table 7). Thus the negative Korean ERP of 'other processed foods' was reduced, and output expanded 5.5%. A similar story can be told regarding the ROW aggregate (which comprises both developing regions as well as the rich EFTA countries) – the 'other processed foods' NRP fell from 13.8% to 8.5% whereas the implicit tax on the agricultural inputs declined from 54% to 34% due to tariff cuts. As a result, 'other processed foods' output expanded 7%. Among remaining developing regions, the output of 'other processed foods' also expanded in several, including Sub-Saharan Africa (4.7%), and South Asia (2.4%). It also expanded 1% in Japan, where the effective protection of the processed food sector also became less negative as a result of the tariff cuts.

One objective of this paper was to explore the impact of increased openness to trade on exports of processed foods from the developing countries. Table 8 shows that the 'cocktail' cuts resulted in an increase in 'other processed foods' exports from the developing world from the base value of US$46 billion to over US$50 billion. At the same time, 'other processed foods' exports from developed countries contracted somewhat. Thus this tariff reform resulted in the developing regions increasing their share of global 'other processed foods' exports. Further, while their exports of this product group to themselves increased by 7%, exports to the developed world rose by over10% as improved access to those markets was obtained. In 1995, ASEAN and Central and South America were the major 'other processed foods' exporters from the developing world, and both increased the value of those exports in this experiment. But by far the largest increase in 'other processed foods' exports, of 42%, occurred from Korea.

[14] These were computed from the updated post-simulation database.

Regional changes in both exports and imports as a result of the simulated tariff cuts are readily summarised by the changes in trade balances, or net exports. Those of 'other processed foods' are also shown in Table 8. The 'cocktail' tariff cuts have increased net exports from developing regions and increased net imports of the developed countries. Among the former group, the surplus of exports over imports in the base year increased in ASEAN, South Asia, Central and South America and Sub-Saharan Africa as a result of the reforms in agricultural tariffs. Net exports from China were reduced, and the net imports of 'other processed foods' in the FSU/Eastern Europe and the Middle East/North Africa increased slightly. But again, the most noticeable change occurred in Korea – in 1995 'other processed foods' imports exceeded exports by US$11 million, but this had reversed to a net export surplus of US$722 million following the tariff cuts.

Turning attention to trade in all processed foods, it is seen from Table 9 that exports from both developed and developing regions increased after the tariff cuts, but the increase was proportionately much greater from the developing group. While the tariff cuts increased the developed countries' net imports of total processed foods, the net import status of the developing countries in the base year was turned around to a net export situation following tariff reforms. Table 10 breaks these changes down to the level of the various processed foods – in the case of the developing regions, the greatest contributions to the increased net exports of US$4.9 million, were from meats and sugar in addition to 'other processed foods'. For the developed regions, the increase in net processed foods imports would have been even greater were it not for their expansion in net exports of the beverages and tobacco aggregate, largely due to an expansion of exports from Australia.

What was the contribution of the cuts in processed food tariffs to the total welfare gained by the developing regions? The decomposition technique of Harrison et al. (1999) was used to partition the total welfare effect of the tariff reductions among the individual commodity tariff shocks. Table 11 shows that the agricultural tariff reductions benefit primarily developed regions, with their total increase in welfare about four times as large as that of developing regions. For both sets of regions, cuts in all processed food tariffs accounted for 60% -70% of the total welfare gains. For the developed countries, dairy tariff cuts made the greatest contribution, followed by beverages and tobacco, meats and sugar. For the developing regions, the tariff cuts on 'other processed foods' made the greatest single contribution, of 35% of developing regions' improvement in welfare

*Experiment 2: Reduction of agricultural and manufacturing tariffs*

In this experiment, the 'cocktail' tariff reductions were extended to include the non-agricultural sectors, that is natural resources, textiles and manufacturing. Such non-agricultural liberalisation may impact on processed food sectors in at least the following two ways. First, they may reduce the cost of non-agricultural inputs to the processed food sector and second, any stimulation to manufacturing activity will impact on the costs of labour and capital and hence that sector will compete with food processing for such resources. The manufacturing sector is an important source of inputs to processed food production in many regions. Manufactured inputs comprise up to 14% of the total costs of 'other processed foods' production, and in many regions is the next most important input after services, capital and labour. The natural resources sector (which includes fishing) is also a significant supplier of inputs to food processing in some regions. While average tariffs on natural resources and manufacturing products do not exceed 10% in the majority of cases in the GTAP database, an average manufacturing tariff of 58% was levied in South Asia.

Table 5 shows effective protection rates of 'other processed foods' following implementation of these additional tariff reductions. In all cases effective protection is increased, or negative protection becomes less negative. Effective protection increased substantially in South Asia - from 2.8% to 7.3% - since cuts to its relatively high manufacturing tariffs reduced the implicit tax on non-agricultural inputs to food processing sector, from 12% down to 8% (Table 7).

When all tariffs are cut, manufacturing outputs expand in some developed regions relative to the situation where tariffs cuts were limited to agricultural goods. This is the case for the USA, the EU and Japan, but also for ASEAN among the developing regions. Similarly, textiles outputs in several developing regions - Korea, South Asia, the Middle East/North Africa and ASEAN - increase by more in this experiment compared with the first. In the ASEAN region and Korea, both the textiles and manufacturing sectors had contracted when only agricultural tariffs were reduced. Such expansions of the labour- and capital-intensive non-agricultural sectors of the developing regions places upward pressure on factor prices (Table 6), particularly in Korea, ASEAN, China and South Asia. Consequently Korean output of 'other processed foods' expands less compared with the first experiment, and this sector's output actually declines in ASEAN. Processed food output in South Asia increases by less in this experiment than in the first, while processed food output in China contracted more in the second experiment than in the first. Of all the developing regions, only in Central and South America and Sub-Saharan Africa did 'other processed foods' output increase relative to the first experiment, and with less competition from the non-agricultural sectors labour and capital price increases were relatively modest in these regions.

Does the developing world still increase its exports of 'other processed foods' relative to the developed world when tariff reforms are extended to all commodities? The answer is yes, but not to the same extent as when reforms are restricted to agricultural items Table 8). The cuts to non-agricultural tariffs reduced the value of 'other processed foods' exports from all developing regions with the exceptions of Central and South America and Sub-Saharan Africa, and total developing countries exports of this commodity were slightly down on those achieved when only agricultural tariffs are reduced. But even with this across-the-board reform of import tariffs, 'other processed foods' exports were above their 1995 values in all developing regions except China. The across-the-board tariff cuts also resulted in levels of net exports of other processed foods from several developing regions that were less than those from the first experiment, again with the exceptions of Central and South America and Sub-Saharan Africa, and increased net imports of processed food into Eastern Europe/FSU and the Middle East/North Africa. But aggregated over all developing regions, net exports of 'other processed foods' were greater than the base values under either tariff reduction scenario.

Cuts in non-agricultural tariffs reduced developing countries' net exports (or increased their net imports) of all remaining processed food commodities (Tables 9 and 10). This effect is most noticeable in the case of beverages and tobacco where net imports increase (as do the net exports of the developed countries). Summed over all processed food commodities, agricultural tariff cuts increase developing countries' net exports by US$4.9 million, which is reduced to an increase of US$2.5 million when non-agricultural items are also included in the reforms. Tariff cuts to only agricultural items reduced developed countries' net exports of all processed food commodities by US$4.2 million, whereas that reduction was limited to US$2.0 million when tariff cuts also incorporate non-agricultural products.

In terms of welfare, how are the gains from this extension of tariff cuts shared between developed and developing regions? When only agricultural tariffs are cut, two-thirds of the

global increase in welfare is enjoyed by developed countries. This is not surprising because agricultural protection is highest in these countries. But when tariffs in all sectors are reformed, both developed and developing countries share equally in the global gains. Thus of the extra US$24 billion global welfare gains from adding non-agricultural items to the tariff reforms, over US$21 billion is received by the developing world. Again, this is not surprising since manufacturing tariffs were highest, and therefore cut the most, in developing countries.

**Conclusions**

Processed foods are increasingly dominating bulk agricultural commodities in total food exports. Such a trend also applies to developing countries' food exports in recent times. While one-half of global processed food trade takes place between developed countries, that between the developing regions is increasing in response to rapid increases in demand for these foods in the developing world. The Uruguay Round generally did not reduce tariffs on processed foods by more than for bulk commodities, so escalation (or de-escalation) of tariffs remains along the processed food production chain. In most of the regions studied here, the implicit tax on agricultural inputs to processed food production exceeded the nominal protection on the processed output. Substantial positive or negative effective protection is computed for some countries, which situation distorts patterns of processed food production and trade.

Others' research had recently shown that developing countries with the most rapid growth in processed food exports tended to be those that were the most 'open' to international trade. An objective of the current paper was to explore the impacts of increased openness on such exports. A number of approaches to reducing agricultural tariffs were discussed, and a 'cocktail' approach was selected since this would produce large cuts to the highest tariffs as well as eliminating low tariffs. While the lion's share of global welfare gains was enjoyed by developed countries, it was shown that cuts to certain processed foods tariffs produced the major share of the developing regions' welfare gain. Increased openness did indeed increase processed food exports from developing countries. In aggregate, the latter had a trade deficit of $4.5 billion in 1995 which was turned around to a surplus on $0.4 billion after implementation of the agricultural tariff cuts.

Another objective was to determine how non-agricultural tariff cuts would interact with processed food trade balances. In many developing countries, substantial increases in labour and capital costs resulted as resources were attracted out of the agricultural sector and into textiles and manufacturing. Nevertheless, processed food exports from developing countries were almost the same as in the first experiment. The land-abundant economies of South America, in contrast to most other developing regions, even increased their processed food exports under this scenario. However, the processed food trade balance in the developing world remained in deficit, although this deficit was lower than in the base case.

The results of this study should be treated as preliminary until improved data become available. Two areas are of particular concern. While we made some improvements to the base tariffs, scope still exists to improve the estimates of agricultural protection. The incorporation of tariff-rate-quotas into the analyses would also promise substantial improvements, since in some cases bulk agricultural commodities may be imported by the food processing sector at low within-quota tariffs, which may not be accurately reflected in our current data. The second data issue concerns the input-output tables, which are at the core of estimates of effective protection. In some cases, these tables are from the 1980s and may have been outdated by rapid structural changes in some developing countries.

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**Table 1 Processed Foods Export Growth Rates (% per year)**

| Processed food | Global | | Developed Regions | | Developing Regions [a] | |
|---|---|---|---|---|---|---|
| | 1975-85 | 1985-95 | 1975-85 | 1985-95 | 1975-85 | 1985-95 |
| Meats | 6.7 | 10.0 | 6.1 | 10.0 | 9.4 | 10.1 |
| Vegetable oils & fats | 7.4 | 4.7 | 5.7 | 4.0 | 9.1 | 5.2 |
| Dairy products | 6.4 | 9.5 | 6.5 | 9.2 | 3.1 | 19.5 |
| Processed rice | 1.9 | 7.5 | 2.4 | 2.3 | 1.6 | 10.3 |
| Sugar | -9.4 | 9.1 | -4.1 | 13.6 | -11.1 | 6.1 |
| Beverages & tobacco | 8.3 | 11.2 | 8.7 | 10.2 | 5.1 | 19.3 |
| 'other processed foods' [b] | 8.4 | 9.7 | 7.8 | 9.0 | 9.7 | 11.0 |
| Total processed foods | 5.3 | 9.4 | 6.6 | 9.2 | 2.8 | 9.9 |

a. Developing countries are all those in the GTAP database with the exceptions of Australia, New Zealand, Japan, Canada, USA, and the member countries of the EU and EFTA.

b. This is the 'food products n.e.c.' commodity in the GTAP database. It includes processed fish, fruits and vegetables; bakery products, confectionery, cereal products excluding rice and processed animal feeds. This group cannot be further disaggregated in the GTAP database.

*Source*: GTAP Version 4 database.

**Table 2 Product Shares of Processed Food Exports (%): 1995**

| | Developed Countries | Developing Countries |
|---|---|---|
| Meats | 20.6 | 12.0 |
| Vegetable oils & fats | 4.1 | 13.2 |
| Dairy products | 13.9 | 1.7 |
| Processed rice | 0.8 | 5.1 |
| Sugar | 3.5 | 8.0 |
| Beverages & tobacco | 18.7 | 7.2 |
| 'other processed foods' | 38.8 | 52.8 |

*Source*: GTAP Version 4 Database

**Table 3 Total Processed Food Trade Between Developed and Developing Regions (% of total trade value)**

| **Exports from**: | **To:** | | | |
|---|---|---|---|---|
| | 1985 | | 1995 | |
| | Developed | Developing | Developed | Developing |
| Developed | 50.9 | 19.1 | 51.8 | 17.1 |
| Developing | 18.5 | 11.4 | 17.0 | 14.4 |

Note: *Source*: GTAP Version 4 Database

**Table 4 The 'Other Processed Foods' Sector – 1995 Protection Data**

| Region | ERP [a] | NRP [b] | Implicit tax [c] on: | |
|---|---|---|---|---|
| | | | Agricultural inputs | Manufactured inputs |
| AU | .043 | 1.031 | 1.023 | 1.029 |
| NZ | .023 | 1.013 | 1.013 | 1.008 |
| JPN | -.162 | 1.068 | 1.483 | 1.022 |
| KOR | -.205 | 1.169 | 1.622 | 1.027 |
| ASEAN | .237 | 1.156 | 1.161 | 1.005 |
| CHINA | .241 | 1.116 | 1.118 | 1.045 |
| STH_ASIA | .167 | 1.277 | 1.441 | 1.119 |
| CAN | .058 | 1.034 | 1.037 | 1.007 |
| USA | .014 | 1.018 | 1.039 | 1.006 |
| CSTH_AMER | .316 | 1.110 | 1.049 | 1.045 |
| EU | -.013 | 1.022 | 1.085 | 1.002 |
| FSU_CEA | .350 | 1.111 | 1.063 | 1.030 |
| ME_NAF | .289 | 1.126 | 1.116 | 1.035 |
| SSA | .170 | 1.081 | 1.076 | 1.030 |
| ROW | -.076 | 1.138 | 1.543 | 1.021 |

a. ERP = effective rate of protection = (VAM-VAW)/VAW, where VAM and VAW are value-added at market prices and world prices, respectively. (See Hertel 1997, p.105)

b. NRP = nominal rate of protection = value food processing output at market prices / value output at world prices

c. Implicit tax on agricultural inputs equals the processing food sector's purchases of agricultural inputs at market prices / value of those purchases at world prices. Implicit tax on the food processing sector's purchases of non-agricultural inputs has a similar interpretation.

*Source:* GTAP Version 4 Database

**Table 5 Impact of Tariff Cuts on the ERP of 'Other Processed Foods'**

| Region | ERP | | |
|---|---|---|---|
| | Base | Experiment 1 | Experiment 2 |
| AU | .043 | -.037 | -.011 |
| NZ | .023 | -.015 | -.003 |
| JPN | -.162 | -.139 | -.135 |
| KOR | -.205 | -.135 | -.107 |
| ASEAN | .237 | .147 | .157 |
| CHINA | .241 | .059 | .103 |
| STH_ASIA | .167 | .028 | .073 |
| CAN | .058 | -.014 | -.007 |
| USA | .014 | -.018 | -.013 |
| CSTH_AMER | .316 | .183 | .217 |
| EU | -.013 | -.042 | -.040 |
| FSU_CEA | .350 | .213 | .256 |
| ME_NAF | .289 | .180 | .205 |
| SSA | .170 | .065 | .096 |
| ROW | -.076 | -.071 | -.064 |

**Table 6 Changes in 'Other Processed Foods' Output and Factor Prices (%)**

| Region | Output | | Market prices of: | | | |
|---|---|---|---|---|---|---|
| | | | Unskilled labour | | Capital | |
| | exp#1 | exp#2 | exp#1 | exp#2 | exp#1 | exp#2 |
| AUS | -1.42 | -0.59 | 2.37 | 2.92 | 2.42 | 3.04 |
| NZL | -3.77 | -2.03 | 3.86 | 4.11 | 3.23 | 3.54 |
| JPN | 1.03 | 1.04 | 0.06 | 0.84 | 0.1 | 0.89 |
| KOR | 5.54 | 5.12 | 0.3 | 4.6 | 0.39 | 4.65 |
| ASEAN | 0.19 | -3.82 | 0.27 | 5.59 | 0.26 | 5.92 |
| CHINA | -2.38 | -2.68 | 0 | 2.68 | 0.05 | 2.84 |
| STH_ASIA | 2.35 | 1.99 | -0.23 | 2.07 | -0.14 | 1.69 |
| CAN | -0.41 | 0.94 | 0.01 | -0.46 | -0.01 | -0.45 |
| USA | 0.29 | 0.33 | 0.1 | 0.61 | 0.09 | 0.6 |
| CSTH_AM | 0.69 | 1.16 | 0.56 | 0.65 | 0.53 | 0.67 |
| EU | -1.64 | -1.36 | -0.27 | -0.18 | -0.22 | -0.12 |
| FSU_CEA | -0.15 | -0.52 | 0.01 | 1.91 | -0.04 | 1.85 |
| ME_NAF | -0.23 | -0.74 | -0.22 | 3 | -0.23 | 2.95 |
| SSA | 4.73 | 5.53 | 0.96 | 1.81 | 0.62 | 1.42 |
| ROW | 7 | 7.38 | -0.44 | 0.07 | -0.64 | -0.09 |

**Table 7 Impacts of Tariff Reductions on the Components of Effective Protection: 'Other Processed Foods'**

| Region | NRP | | Implicit tax on: | | | |
|---|---|---|---|---|---|---|
| | | | Agricultural inputs | | Manufactured inputs | |
| | Base | Exp#1 | Base | Exp#1 | Base | Exp#2 |
| AU | 1.031 | 1.000 | 1.023 | 1.001 | 1.029 | 1.008 |
| NZ | 1.013 | 1.001 | 1.013 | 1.005 | 1.008 | 1.000 |
| JPN | 1.068 | 1.004 | 1.483 | 1.166 | 1.022 | 1.018 |
| KOR | 1.169 | 1.094 | 1.622 | 1.320 | 1.027 | 1.000 |
| ASEAN | 1.156 | 1.097 | 1.161 | 1.096 | 1.005 | 0.993 |
| CHINA | 1.116 | 1.059 | 1.118 | 1.066 | 1.045 | 1.019 |
| STH_ASIA | 1.277 | 1.173 | 1.441 | 1.287 | 1.119 | 1.078 |
| CAN | 1.034 | 1.000 | 1.037 | 1.010 | 1.007 | 1.000 |
| USA | 1.018 | 1.000 | 1.039 | 1.022 | 1.006 | 0.999 |
| CSTH_AMER | 1.110 | 1.065 | 1.049 | 1.011 | 1.045 | 1.021 |
| EU | 1.022 | 1.000 | 1.085 | 1.049 | 1.002 | 1.000 |
| FSU_CEA | 1.111 | 1.068 | 1.063 | 1.020 | 1.030 | 1.007 |
| ME_NAF | 1.126 | 1.079 | 1.116 | 1.063 | 1.035 | 1.019 |
| SSA | 1.081 | 1.041 | 1.076 | 1.036 | 1.030 | 1.008 |
| ROW | 1.138 | 1.085 | 1.543 | 1.339 | 1.021 | 1.007 |

**Table 8 'Other Processed Foods' Total and Net Exports (US$million)**

| Region | Total exports | | | Net exports | | |
|---|---|---|---|---|---|---|
| | Base | # 1 | # 2 | Base | # 1 | # 2 |
| DEVELOPED | | | | | | |
| AUS | 1,693 | 1,656 | 1,715 | 374 | 175 | 244 |
| NZL | 1,158 | 1,130 | 1,162 | 775 | 705 | 737 |
| JPN | 1,275 | 1,651 | 1,676 | -18,574 | -18,552 | -18,621 |
| CAN | 3,824 | 4,001 | 4,150 | 202 | 132 | 310 |
| USA | 11,826 | 12,764 | 12,884 | 24 | 431 | 512 |
| EU | 52,278 | 50,555 | 51,136 | -5,023 | -8,442 | -7,869 |
| Sub-total | 72,055 | 71,756 | 72,724 | -22,222 | -25,551 | -24,687 |
| DEVELOPING | | | | | | |
| KOR | 1,865 | 2,656 | 2,592 | -11 | 722 | 619 |
| ASEAN | 10,782 | 11,516 | 10,816 | 5,742 | 5,847 | 4,962 |
| CHINA | 5,556 | 5,481 | 5,461 | 590 | 26 | -92 |
| STH_ASIA | 2,497 | 2,706 | 2,705 | 2,153 | 2,281 | 2,274 |
| CSTH_AM | 14,882 | 16,225 | 16,669 | 9,369 | 10,130 | 10,616 |
| FSU_CEA | 4,825 | 5,407 | 5,385 | -3,151 | -3,228 | -3,344 |
| ME_NAF | 2,834 | 3,175 | 3,070 | -1,759 | -1,808 | -2,069 |
| SSA | 2,775 | 3,254 | 3,297 | 852 | 1,161 | 1,200 |
| Sub-total | 46,016 | 50,420 | 49,996 | 13,786 | 15,130 | 14,165 |
| Totals | 118,071 | 122,176 | 122,170 | -8,437 | -10,421 | -10,521 |

Note: Excludes the ROW

**Table 9 Total Processed Foods: Exports and Net Exports (US$billion)**

| | Base | # 1 | # 2 |
|---|---|---|---|
| TOTAL EXPORTS | | | |
| Developed regions | 191.1 | 196.4 | 198.9 |
| Developing regions | 87.5 | 101.7 | 101.0 |
| NET EXPORTS | | | |
| Developed regions | -9.9 | -14.2 | -12.0 |
| Developing regions | -4.5 | 0.4 | -2.0 |

Note: Excludes the ROW

**Table 10 Changes in Net Exports of All Processed Foods (US$billion)**

| Processed Item | Experiment 1 | | Experiment 2 | |
|---|---|---|---|---|
| | Developed regions | Developing regions | Developed regions | Developing regions |
| Meats | -1.7 | 2.0 | -1.4 | 1.7 |
| Vegetable oils & fats | 0.7 | -0.3 | 0.9 | -0.5 |
| Processed rice | -0.3 | 0.3 | -0.3 | 0.2 |
| Beverages & tobacco | 1.9 | -0.6 | 2.5 | -1.2 |
| 'other processed foods' | -3.3 | 1.3 | -2.5 | 0.4 |
| Dairy products | -0.2 | 0.9 | -0.0 | 0.7 |
| Sugar | -1.3 | 1.2 | -1.3 | 1.1 |
| TOTALS | -4.2 | 4.9 | -2.0 | 2.5 |

Note: Excludes the ROW

**Table 11 Decomposition of Welfare Changes by Agricultural Commodity Tariff Shocks: Experiment #1**

| Sector | Change in Welfare | | | |
|---|---|---|---|---|
| | $millions | | % of total change | |
| | Developed regions | Developing regions | Developed regions | Developing regions |
| Raw commodities: | | | | |
| Wheat | 2589 | -341 | 11.3 | -6.1 |
| Other grains | 2847 | 375 | 12.5 | 6.7 |
| Oilseeds | -45 | 60 | -0.2 | 1.1 |
| Rice | 20 | 11 | 0.1 | 0.2 |
| Vegetables & fruits | -273 | 577 | -1.2 | 10.4 |
| Sugar cane & beet | 407 | 165 | 1.8 | 3.0 |
| Other crops | -24 | 1267 | -0.1 | 22.8 |
| Livestock | 799 | -29 | 3.5 | -0.5 |
| Sub-total | 6320 | 2085 | 27.7 | 37.5 |
| Processed commodities: | | | | |
| Meats | 3034 | 507 | 13.3 | 9.1 |
| Vegetable oils & fats | 175 | 333 | 0.8 | 6.0 |
| Processed rice | 442 | 223 | 1.9 | 4.0 |
| Beverages & tobacco | 4373 | 1413 | 19.2 | 25.4 |
| 'other processed foods' | -1092 | 1963 | -4.8 | 35.3 |
| Dairy products | 6783 | -1288 | 29.7 | -23.2 |
| Sugar | 2797 | 327 | 12.3 | 5.9 |
| Sub-total | 16512 | 3478 | 72.3 | 62.5 |
| Grand total | 22832 | 5563 | 100 | 100 |

Note: ROW region omitted.

**Appendix Table 1 Aggregation of GTAP Version 4 Regions**

| Acronym | Description | Acronym | Description |
|---|---|---|---|
| AUS | Australia | USA | USA |
| NZL | New Zealand | CSTH_AM | Mexico, Central & South America |
| JPN | Japan | EU | EU |
| KOR | South Korea | FSU_CEA | Former Soviet Union, Central European Associates |
| ASEAN | Indonesia, Malaysia, Philippines, Thailand, Singapore, Vietnam | ME_NAF | Middle East & North Africa |
| CHINA | China, Hong Kong, Taiwan | SSA | Sub-Saharan Africa and Southern Africa |
| STH_ASIA | India, SriLanka, rest of South Asia | ROW | Rest of world |
| CAN | Canada | | |

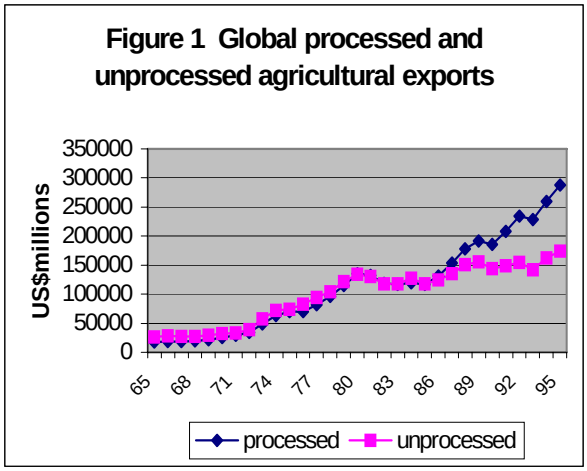
Figure 1 Global processed and unprocessed agricultural exports
US$millions
350000
300000
250000
200000
150000
100000
50000
0
65 68 71 74 77 80 83 86 89 92 95
processed
unprocessed

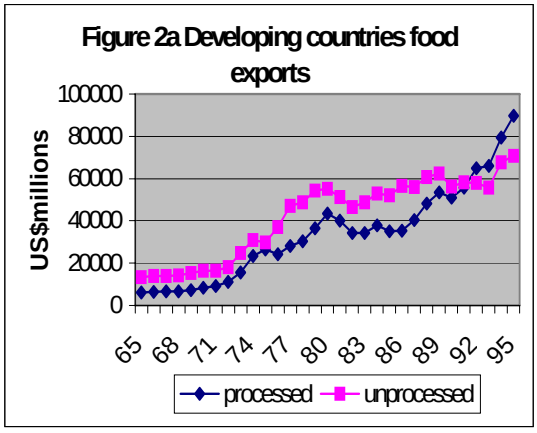
Figure 2a Developing countries food exports
US$millions
100000
80000
60000
40000
20000
0
65 68 71 74 77 80 83 86 89 92 95
processed
unprocessed

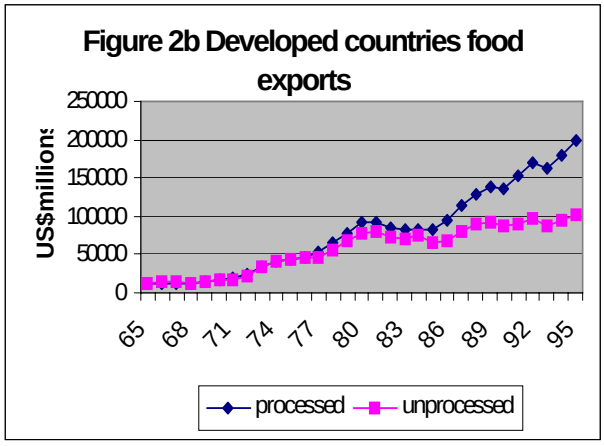
Figure 2b Developed countries food exports
US$millions
250000
200000
150000
100000
50000
0
65 68 71 74 77 80 83 86 89 92 95
processed
unprocessed